

## CLAIMS

We claim:

- 1 1. A waveguide comprising:
  - 2 at least one outer surface defining a waveguide cavity; and
  - 3 at least one inner surface positioned within said waveguide cavity, wherein said
  - 4 inner surface comprises a frequency selective surface (FSS) having a plurality of
  - 5 frequency selective surface elements coupled to at least one substrate, said substrate
  - 6 defining a first propagation medium such that an RF signal having a first wavelength in
  - 7 said first propagation medium can pass through said frequency selective surface;
  - 8 wherein said frequency selective surface is coupled to a second propagation
  - 9 medium such that in said second propagation medium said RF signal has a second
  - 10 wavelength which is at least twice as long as a physical distance between centers of
  - 11 adjacent ones of said frequency selective surface elements.
- 1 2. The waveguide of claim 1, wherein said second wavelength is different than
- 2 said first wavelength.
- 1 3. The waveguide of claim 1, wherein said substrate comprises a dielectric having
- 2 at least one of a relative permittivity and a relative permeability which is greater than 3.
- 1 4. The waveguide of claim 1, wherein said frequency selective surface comprises
- 2 a plurality of dielectric layers.

1       5.     The waveguide of claim 1, wherein said frequency selective surface comprises  
2     at least one dielectric layer for matching an impedance of said first propagation  
3     medium to an impedance of said second propagation medium.

1       6.     The waveguide of claim 1, wherein said frequency selective surface elements  
2     comprise apertures in a conductive surface.

1       7.     The waveguide of claim 1, wherein said frequency selective surface elements  
2     comprise conductive elements.

1       8.     An antenna for microwave radiation comprising:  
2             a first horn; and  
3             at least a second horn positioned within said first horn, said second horn  
4     comprising at least one frequency selective surface having a plurality of frequency  
5     selective surface elements coupled to at least one substrate, said substrate defining a  
6     first propagation medium such that an RF signal having a first wavelength in said first  
7     propagation medium can pass through said frequency selective surface;  
8             wherein said frequency selective surface is coupled to a second propagation  
9     medium such that in said second propagation medium said RF signal has a second  
10    wavelength which is at least twice as long as a physical distance between centers of  
11    adjacent ones of said frequency selective surface elements.

1       9.     The antenna of claim 8, wherein said second wavelength is different than said  
2     first wavelength.

1       10.    The antenna of claim 8, further comprising at least a third horn positioned within  
2     said second horn, said third horn comprising at least one frequency selective surface.

1       11.    The antenna of claim 8, wherein said substrate comprises a dielectric having at  
2     least one of a permittivity and a permeability which is greater than 3.

1       12.    The antenna of claim 8, wherein said frequency selective surface elements  
2     comprise apertures in a conductive surface.

1       13.    The antenna of claim 8, wherein said frequency selective surface elements  
2     comprise conductive elements.

1       14.    The antenna of claim 8, wherein said frequency selective surface comprises a  
2     plurality of dielectric layers.

1       15.    The antenna of claim 8, wherein said frequency selective surface comprises at  
2     least one dielectric layer matching an impedance of said first propagation medium to  
3     an impedance of said second propagation medium.

1       16.    A waveguide horn antenna comprising,

2           a tapered hollow metallic conductor; and  
3           a frequency selective surface comprising a substrate and an array of elements  
4       defining at least one wall of said horn, said frequency selective surface positioned for  
5       confining and guiding a propagating electromagnetic wave;  
6           said substrate having at least one of a permeability and a permittivity greater  
7       than about three.

1       17. The waveguide horn antenna according to claim 16 wherein said frequency  
2       selective surface is comprised of concentric ring slots.

1       18. A method for improving performance in a horn antenna comprising the steps of:  
2           forming at least one wall of said horn antenna of a frequency selective surface;  
3       and  
4           selectively reducing at least one grating lobe of said antenna by increasing at  
5       least one of a permittivity and a permeability of a substrate comprising said frequency  
6       selective surface to a value greater than three.

1       19. The method according to claim 18 further comprising the step of increasing said  
2       value of at least one of said permeability and said permittivity to between about 10 and  
3       100.

1       20. The method according to claim 18 further comprising the step of reducing at  
2       least one grating lobe of said antenna by decreasing a spacing between adjacent  
3       elements of said frequency selective surface.